VARIATIONS OF GLACIERS. XVII[1]

HARRY FIELDING REID
Johns Hopkins University, Baltimore, Maryland

The following is a summary of the *Sixteenth Annual Report* of the International Committee on Glaciers.[2]

THE REPORT OF GLACIERS FOR 1910

Swiss Alps.—The summer of 1910 was extremely wet and snowy, which interfered materially with the measures of the glaciers; nevertheless it was found that the retreat is still general, although it is becoming less and less marked. Of the fifty-four glaciers measured, only two are actually advancing, namely the Sex Rouge and the Lower Grindelwald; some others show indications of possible advance; all in this class lie north of the Rhone and Rhine valleys.

Eastern Alps.—In this region also the wet summer interfered with observations. Two glaciers, in addition to the one mentioned last year, are advancing. In general, the glaciers are in retreat. Many ice avalanches fell in a part of the Oetztal, which was formerly free of ice.

Italian Alps.—The retreat here also is general. On account of the heavy snowfall some small glaciers were covered with snow to their ends during the whole summer, so that good observations could not be made. This was especially true of the Lombardy and Venetian Alps.

French Alps.—Many snow gauges have been set up by the French government and they show a decided increase in the snowfall in comparison with the average of the last ten years. At Sixt the snowfall was twice as great as the average. The quantity of snow which has come down in the form of avalanches is also materially greater. Although the glaciers in the *massif* of Mont Blanc, in the Tarentaise, in the Maurienne, and in the Dauphiné are all retreating, they seem to be increasing in thickness at the

[1] Earlier reports appeared in the *Journal of Geology*, III–XIX.

[2] *Zeitschrift für Gletscherkunde*, VI (1911), 81–103.

higher levels; and there is every indication of an approaching advance. The snow fields are increasing in size and vegetation is taking hold on the barren areas below the ends of the glaciers, indicating apparently a more moist climate.

Swedish Alps.—Of the five glaciers reported, all are apparently advancing.

Norwegian Alps.—In Norway a large number of glaciers are measured; during the last year the changes have been mixed, some advancing and some retreating, but an examination of the lists shows that on the whole the changes are distinctly toward an advance.

Africa.—Photographs of Kilimanjaro taken in 1898, 1904, and 1906 show that the glaciers on this volcano are retreating. A photograph taken in 1901 indicated an increased accumulation of snow in the crater, but in spite of this the glaciers are becoming smaller.

REPORT ON THE GLACIERS OF THE UNITED STATES FOR 1911[1]

The Hallett Glacier shows no measurable change (Mills).

More snow than usual was found on the Arapahoe Glacier, but the end suffered a slight recession (Henderson).

Eliot Glacier on Mt. Hood continues its retreat (Langille).

Professor U. S. Grant and Mr. D. F. Higgins have continued their descriptions of some Alaskan glaciers.[2] Their latest observations were in 1909. They found that the Yale Glacier occupied about the same position as in 1899; that the Harvard Glacier had advanced a quarter to a half-mile, and the Bryn Mawr Glacier about 500 feet between 1905 and 1909. The position of the Barry Glacier is known for 1899, 1905, 1908, 1909; since 1899 it has retreated about 2 miles, and the rate of retreat seems to be increasing. Between 1905 and 1909 Toboggan Glacier advanced about 400 feet and then retreated about 650 feet. Many other glaciers were photographed

[1] A synopsis of this report will appear in the *Seventeenth Annual Report* of the International Committee. The report on the glaciers of the United States for the year 1910 was given in this *Journal*, XIX, 455–61.

[2] "Glaciers of Prince William Sound, and the Southern Part of the Kenai Peninsula, Alaska," *Bull. Amer. Geog. Soc.* (1910), XLII, 721–38; (1911) XLIII, 321–38, 401–17, 721–37.

and maps made of their ends. In general, where definite information was obtainable the glaciers proved to be in retreat, but some of them appeared to be advancing. Evidence was found of an advance of Columbia Glacier perhaps 50 years ago, and also of an earlier recession. About 1894 there was an advance, followed by a retreat. In 1905 the ice had retreated 160 feet behind its limit in 1899, but had regained 100 feet in 1908. Between July 15, 1908, and August 23, 1909, the ice advanced 380 feet.

Professor Lawrence Martin sends me the following account of the changes in a number of Alaskan glaciers between 1910 and 1911[1]:

Copper River.—The Childs Glacier, which advanced about 1,800 feet between the spring of 1909 and the autumn of 1910, for the most part in the season of 1910, moved forward 97 feet in the following eight months.[2] This movement, measured at the northern margin, where the glacier was only 1,474 feet from the Copper River and Northwestern Railway bridge in 1911, is at a much less rapid rate than during the previous summer, and the Copper River railway bridge is probably safe from the glacier during the closing stages of the present period of spasmodic advance; the river will probably always protect the bridge by undercutting the ice front during periods of rapid advance which come at high water, for the summer volume of the river is about equal to that of the Mississippi. This brief, spasmodic advance of Childs Glacier suggests the earthquake avalanche type seen 190 miles east in Yakutat Bay.

Miles Glacier, whose advance from 1908 to 1910 was 1,800 to 4,000 feet, in different portions of the ice cliff, had nearly ceased its rapid forward movement in June, 1911. The Grinnell Glacier continued during the winter of 1910–11 a slight advance, commenced the summer before. Allen Glacier showed no changes from 1910 to 1911. The Heney Glacier, which was stagnant for a long time before September, 1910, was newly crevassed and beginning to advance in June, 1911.

Southeast of Mt. Wrangell, the Kennicott Glacier, at whose margin a railway has recently been built, is stagnant and inactive, as it has been since before 1898. The Chitistone Glacier, some distance east of the Kennicott, is reported by R. F. McClellan to have advanced about half a mile during the winter of 1910–11.

Alaskan Range.—The Gulkana, Cantwell, Castner, and a large unnamed glacier near Rapids Roadhouse were inactive and retreating in 1911, as they have been for several years.

[1] See also Lawrence Martin, "The National Geographical Society Researches in Alaska," *Nat. Geog. Mag.*, June, 1911.

[2] In the table giving the variations of the Childs Glacier in the last report, "Advance in Feet" should be substituted for "Advance in Meters."

Prince William Sound.—Columbia Glacier, which advanced more than 1,700 feet between 1908 and 1910, has continued a slow forward movement, apparently due to climatic causes. The western margin advanced a little less than 100 feet from September 5, 1910, to June 21, 1911. The Valdez Glacier continued to retreat from 1910 to 1911, the amount of recession from June, 1909, to June, 1911, being reported by the late L. S. Camicia, of Valdez, as 36 feet.

Kenai Peninsula.—Spencer Glacier, close to the Alaska Northern Railway, retreated only 36 feet between January 8, 1906, and June 26, 1911. Glacier streams from this ice tongue have deposited outwash gravels so that twenty trestles in a distance of 1½ miles along the railway were filled and had to be abandoned. An elaborate and successful attempt to divert the glacial streams was carried out while the National Geographic Society party was at Spencer Glacier in June, 1911. As a result of the work of man in blasting a channel in the ice and producing two new subglacial stream courses, this glacier will probably retreat more rapidly in the next few years. Bartlett Glacier near the same railway is inactive and retreating.

Yakutat Bay.—A Boundary Survey party under N. J. Ogilvie visited Yakutat Bay in 1911 and took photographs from a number of sites occupied by Tarr and Martin in previous years. These photographs, furnished through the courtesy of Boundary Commissioner W. F. King, show the following: Nunatak Glacier, which retreated 2½ miles between 1890 and 1909 and advanced 1,000 feet the following year, made a further slight advance by the summer of 1911. The front of Hubbard Glacier had almost the same position in 1910 and 1911. The northern margin of Turner Glacier retreated slightly. The crevasses in Variegated Glacier, which was impassable in 1906, had so far healed by melting that in 1911 the Boundary Survey party traveled up the glacier to its head. Lucia Glacier, which was impassable in 1909, was traversed by the same party in 1911; so was Marvine Glacier, which was impassable in 1906.

Glacier Bay.—Muir Glacier retreated about 2,000 feet between 1907 and August 30, 1911. The thinning of the glacier by ablation and flow is an even more impressive feature than the retreat of the tidal ice front. It was possible, for example, in 1911, to walk upon a beach where, in 1907, there was an ice cliff, and where, in 1892, the ice was 1,200 feet thick. Tree stumps 12 to 18 inches in diameter, uncovered by the melting of the ice, show that the maximum advance of the eighteenth century was preceded by a minimum when Muir Glacier was even more emaciated than in 1911.

Other ice tongues in Glacier Bay which have continued receding are the following: Carroll Glacier had retreated so far that the eastern part of it did not touch the sea at low tide in 1911. A great delta had been built forward from nearly the middle of the ice cliff. Ablation had also removed the western distributary of Cushing Glacier, which previously spilled over to Carroll Glacier. Grand Pacific Glacier is retreating less rapidly than it did between 1899 and 1907, possibly because it is about to cease to be tidal. Johns Hopkins

Glacier is nearly separated into two independent ice tongues. Charpentier and Favorite Glaciers have been dismembered since 1906 by recession. Reid, Hugh Miller, Wood, and Geikie glaciers in Glacier Bay and Brady Glacier in Taylor Bay have changed less rapidly, though they are still receding.

La Perouse Glacier, west of Mt. Fairweather, and 130 miles southeast of Yakutat Bay, changed very little between 1910 and 1911, apparently having had in 1910 a brief spasmodic advance of the earthquake avalanche type.

In contrast with the other ice tongues of Glacier Bay, Rendu and an adjacent unnamed glacier have made notable advances. The former retreated about 2,000 feet between 1892 and 1907; it then advanced at least 8,350 feet and retreated again 600 feet by September, 1911. If the rate of the last retreat was about the same as the earlier one, the whole of the remarkable advance must have taken place in 1907. As Rendu Glacier is only 120 miles southeast of Yakutat Bay where nine or more glaciers have advanced since 1899 in response to earthquake avalanching, its advance may have been due to the same cause, and it will be interesting to see whether any of the other ice tongues of Glacier Bay push forward within the next few years. The small cascading glacier immediately south of Rendu Glacier has advanced a quarter-mile since 1907 and was discharging icebergs in 1911.

Southeastern Alaska.—Rainy Hollow Glacier, northwest of Lynn Canal, advanced more than 2,000 feet between June and September, 1910, as observed by the late Webster Brown. This brief, spasmodic advance in an ice tongue only 120 miles east of Yakutat Bay suggests the earthquake avalanche cause for activity. Davidson Glacier in Lynn Canal is still inactive; it changed little between the visit of G. K. Gilbert in 1899 and that of the National Geographic Society party in 1911. Eagle, Herbert, and Mendenhall glaciers, north of Juneau, which have recently been mapped in detail by the United States Geological Survey, seemed, as seen from a distance in 1911, to have suffered little change in recent years. Taku Glacier continued to retreat from 1907 to 1911. Norris Glacier, which was advancing and destroying vegetation when visited by F. E. and C. W. Wright in 1906, was advancing slightly and overriding shrubs in 1911. None of the ice tongues on the Stikine River displayed signs of abnormal activity in September, 1911. Popoff Glacier has retreated considerably since 1904.

The Kahiltna, Tokichitna, and Little Tokichitna glaciers, on the eastern side of the Alaskan Range, have large trees growing very close to their ends, indicating a stationary or advancing phase (S. R. Capps). But the glaciers on the western side of the range seem to be in retreat (Brooks).[1] About 30 miles east of Cape Yakataga the Malaspina Glacier has receded about 10 miles, leaving a good harbor (H. Horick).

[1] "The Mt. McKinley Region, Alaska," *Professional Paper 70, U.S. Geol. Surv.*, Washington, 1911.